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(54) Tufted carpeting having an improved backing and process of making same

(57) Pile yarn fibers (301) are tufted into a tufting backing (302), which is composed of a primary backing (301a), a secondary backing (302c), and an elastomer (302b) sandwiched between the primary and secondary backings. In another embodiment, the tufting backing comprises a primary backing and an elastomer applied to the primary backing, but does not include a secondary backing. The elastomer (302b) is applied to the primary backing in a non-contiguous form whereby voids (302d) are provided within the arrangement for the tufting backing to be tufted without the primary backing fibers being immobilized. After the pile yarn fibers are tufted into the tufting backing, the elastomer is heated such that it softens, allowing the elastomer to flow in and around the pile yarn fibers. The elastomer may then be cooled, thereby hardening the elastomer and bonding the pile yarn fibers to the primary backing.

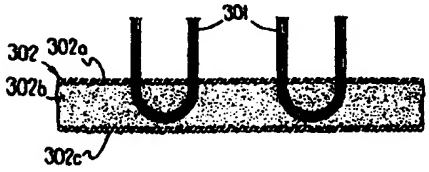

FIG 3A

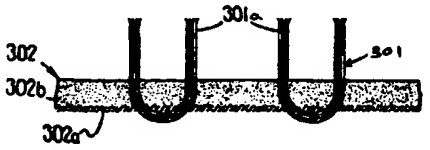

FIG 3B

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This invention relates generally to tufted products. Particularly, this invention relates to tufted carpet having an improved tufting backing and a method of making such tufted carpet and tufting backing.

Many types of carpet, as well as other fabrics, are prepared by the process of "tufting", whereby fibers, such as pile yarn fibers, are forced through a backing material. For example, with respect to tufted carpet, lengths of pile yarn fiber may be forced through the backing so that both ends of the pile yarn fiber extend on one side of the backing. A plurality of pile yarn fibers are tufted into the backing so as to create the carpet.

A current process for making tufted carpet is depicted in FIG. 2, and includes several steps in addition to the tufting of the pile yarn fibers. The process of FIG. 2 results in the tufted carpet depicted in FIG. 1. Referring to FIGS. 1 and 2, pile yarn fibers 101 are first tufted into a primary backing 102, which may comprise a woven or non-woven polypropylene sheet, in step 201. After the fibers 101 have been tufted into the primary backing 102, the fibers 101 may be dyed a specific color, and the carpet is then dried, as shown in step 202. In step 203, a layer of latex 103 is applied to the back of the carpet (e.g., the side of the primary backing opposite the side containing the extended ends of the pile yarn fibers), and a secondary backing 104, either woven or non-woven, is applied onto the latex. Finally, in step 204, the carpet is cooled and rolled up.

In the prior art carpet shown in FIG. 1, the layer of latex 103 bonds to the pile yarn fibers 101, and serves to hold the fibers 101 in place. Latex 103 commonly may consist of many compounds, including a phenylcyclohexene compound, which is used because of its ability to bond to the fibers as it dries. Unfortunately, phenylcyclohexene has also recently been found by some people to be carcinogenous (cancer-causing), making it unsuitable for use with carpet which comes into contact with humans.

Additionally, because of the numerous steps currently utilized to make tufted carpet, prior art methods of making tufted carpet is relatively expensive. Complex machinery is needed to perform the necessary steps, and a significant amount of material, time and labour are needed to make the carpet. Furthermore, given the characteristics of phenylcyclohexene, the bonding strength of the latex 103 with the pile yarn fibers 101 is limited, leading to the potential for pile yarn fibers 101 to be pulled out of the carpet.

According to a first aspect of the present invention, there is provided a method of making tufting backing adapted for tufting pile yarn fibers therethrough, the method comprising the steps of:

(a) preparing an elastomer for application to a primary backing; and,

(b) applying the elastomer to a first side of the primary backing, wherein the elastomer is applied to the primary backing in a form which creates at least one void on the first side of the primary backing.

According to a second aspect of the present invention, there is provided a tufting backing adapted for tufting pile yarn fibers therethrough, the tufting backing comprising:

(a) a primary backing; and,

(b) an elastomer applied to a first side of the primary backing, wherein the elastomer is applied to the primary backing in a form which creates at least one void on the first side of the primary backing.

According to a third aspect of the present invention, there is provided a method of making carpet, the method comprising the steps of:

(a) applying an elastomer to a first side of a primary backing having at least one primary backing fiber, wherein the elastomer is applied to the first side of the primary backing in a form which creates at least one void on the first side of the primary backing; and,

(b) tufting at least one pile yarn fiber through the primary backing with a tufting needle wherein the at least one void allows the at least one primary backing fiber to shift when the tufting needle meets the at least one primary backing fiber.

According to a fourth aspect of the present invention, there is provided a carpet comprising:

(a) a primary backing having at least one primary backing fiber;

(b) an elastomer applied to a first side of the primary backing in a form which creates at least one void on the first side of the primary backing; and,

(c) at least one pile yarn fiber tufted through the primary backing with a tufting needle, wherein the at least one void allows the at least one primary backing fiber to shift when the tufting needle meets the primary backing fiber.

The elastomer may comprise a thermoplastic, such as ethylene/vinyl acetate (EVA). After the pile yarn fibers are tufted into the tufting backing, the carpet may be dyed and heated to dry the dye as well as to soften the thermoplastic elastomer, allowing the thermoplastic elastomer to flow in and around the pile yarn fibers. The thermoplastic elastomer may then be cooled, thereby bonding the pile yarn fibers to the tufting backing.

By applying the elastomer to the primary backing in the non-contiguous form, the retained strength of the tufting backing is improved during and subsequent to the tufting process. The im-

proved strength results because, unlike with a solid sheet form of elastomer, the primary backing fibers are not immobilized as the tufting needles force the pile yarn through the tufting backing. One method of applying the elastomer to the primary backing in the non-contiguous form includes heating the elastomer until it melts, pumping the elastomer onto the primary backing through a die having small orifices, and cooling the elastomer with one or more chilled rollers.

To improve the bonding of the elastomer to the primary backing, the primary backing may be treated with a corona discharge or gas flame. Further, suctioning the elastomer to the primary backing with a vacuum may also be used to improve the bonding.

In the drawings:

FIG. 1 depicts a side-view of tufted carpet known in the prior art.

FIG. 2 depicts a prior art process diagram for making the prior art tufted carpet depicted in FIG. 1.

FIG. 3A depicts a side-view of tufted carpet according to a preferred embodiment of the present invention.

FIG. 3B depicts a side-view of tufted carpet according to another embodiment of the present invention.

FIG. 4A depicts a process diagram for making the tufted carpet depicted in FIGS. 3A or 3B, according to a preferred embodiment of the present invention.

FIG. 4B depicts a process diagram for making the tufted carpet depicted in FIGS. 3A or 3B, according to another embodiment of the present invention.

FIG. 5 depicts a process diagram for making the tufting backing depicted in FIGS. 3A or 3B, according to a preferred embodiment of the present invention.

FIG. 6A depicts a top-view of tufting backing with a solid sheet form of elastomer.

FIG. 6B depicts a top-view of tufting backing with a non-contiguous form of elastomer according to a preferred embodiment of the present invention.

FIG. 6C depicts a top-view of tufting backing with a non-contiguous form of elastomer according to another embodiment of the present invention.

FIG. 6D depicts a top-view of tufting backing with a non-contiguous form of elastomer according to yet another embodiment of the present invention.

FIG. 7A depicts a side-view of tufted carpet with a solid sheet form of elastomer prior to melting the elastomer.

FIG. 7B depicts a side-view of tufted carpet with a non-contiguous form of elastomer prior to melting the elastomer.

FIG. 7C depicts an isolated exploded perspective of a void created on a primary backing prior to the tufting of pile yarn fibers.

FIG. 7D depicts an isolated exploded perspective of a void created on a primary backing subsequent to the tufting of pile yarn fibers.

Referring to FIG. 3A, a side-view of tufted carpet is depicted according to a preferred embodiment of the present invention. Particularly, a tufting backing 302 is provided through which one or more pile yarn fibers 301 are tufted. In a preferred embodiment, pile yarn fibers 301 may comprise fibers made of nylon or polypropylene, commonly available from many sources, such as Shaw Industries, Beaulieu Inc., Hercules, etc., and sold under various brand names. Of course, other equivalent pile yarn fibers 301, or other fibers, may be used as well.

In one embodiment, tufting backing 302 may comprise a primary backing 302a, a secondary backing 302c, and an elastomer 302b sandwiched between primary backing 302a and secondary backing 302c. Primary backing 302a and secondary backing 302c may be formed of either woven or non-woven fibers, and may comprise a polypropylene sheet in a preferred embodiment. For example, primary backing 302a and secondary backing 302c may comprise woven polypropylene having a weight of 3.5 ounces/yard^2, or non-woven polypropylene having a weight of 3 ounces/yard^2. Such backing is available from General Fibers and Fabrics, the intended assignee of the present invention, and sold under the brand name "Supertuft" (a trademark of General Fibers and Fabrics). Of course, any other equivalent material may be used as well, such as jute, etc.

In another embodiment, tufting backing 302 may be made without secondary backing 302c, as depicted in FIG. 3B. In this case, only primary backing 302a and elastomer 302b are present, and pile yarn fibers 301 are therefore only tufted through these two layers. In this configuration tufting backing 302 operates in a similar manner as when a secondary backing 302c is also present, except that less material is necessary.

Tufting backing 302 may be made in one of a variety of commonly known ways. For example, in a preferred embodiment, tufting backing 302 may be made by utilizing turnkey equipment available from several sources. Such equipment is available from such well-known manufacturers as Bouligny of Charlotte, North Carolina; Meccaniche Moderne of Busto Arsizio, Italy; Reifenhausen of Troisdorf, Germany; and Lurgi of Frankfurt, Germany.

Those of ordinary skill in the art will readily recognize that non-turnkey equipment may be readily implemented by utilizing various pieces of equipment available from these and other manufacturers. It will be readily recognized that there are numerous known methods to prepare tufting backing 302, and the present invention shall not be deemed to be limited to any one method.

FIG. 5 shows the various steps which may be taken in order to make tufting backing 302. First, in step 501, in order to adhere elastomer 302b onto primary backing 302a, elastomer 302b may be heated to a temperature so as to completely melt elastomer 302b. For example, in a preferred embodiment, elastomer 302b may be heated to a temperature of approximately 177-203 degrees C (350-400 degrees F). Thereafter, the melted elastomer 302b is applied to primary backing 302a in step 502, elastomer 302b is cooled in step 503, and elastomer 302b thereby adheres to primary backing 302a. In one embodiment, the cooling step 503 may be performed by exposing elastomer 302b to the surrounding room temperature environment.

FIGS. 6A, 6B, 6C and 6D illustrate forms in which the elastomer 302b may be applied to the primary backing 302a. The two forms are solid sheet and, in accordance with the invention, non-contiguous (fully or partially).

FIG. 6A depicts elastomer 302b applied to the primary backing 302a in the solid sheet form. The solid sheet form of the elastomer 302b is a continuous distribution of elastomer 302b which covers all or a portion of the primary backing 302a. Further, the solid sheet form of elastomer 302b does not leave any voids on the surface of the primary backing 302a portion covered by the solid sheet form of elastomer 302b.

FIGS. 6B, 6C and 6D show elastomer 302b applied to the primary backing 302a in a non-contiguous form whereby voids 302d are provided on the surface of the primary backing 302a. Voids 302d may be created on the surface of the primary backing 302a by applying the elastomer in portions having different shapes and sizes. Specifically, FIG. 6B illustrates the elastomer 302b applied in strands, also referred to as ribs, and FIG. 6C depicts the elastomer 302b applied in dashes, where the voids 302c are created between the strands and dashes, respectively. FIGS. 6B and 6C are examples of fully non-contiguous forms of elastomer because the strands and dashes do not touch in their respective illustrated formations.

FIG. 6D illustrates the elastomer 302b applied to the primary backing 302a in a partially non-contiguous form, where the voids 302d are created by applying the elastomer in dashes in a checkerboard format such that the corners of the dashes touch but the side edges of the dashes do not touch. As one of ordinary skill in the art will readily recognize, the elastomer 302b may be applied to the primary backing 302 in the non-contiguous form in many other shapes, such as dots, where the strands, dashes and dots may take almost any geometric shape including but not limited to a square, rectangle, triangle, and circle. A void 302d in the non-contiguous sheet form may also take many geometric shapes including but not limited to a square, rectangle, triangle, and circle. Finally, one of ordinary skill in the art will also readily understand that many other formats, in addition to the checkerboard format, may be utilized.

The solid sheet form of elastomer 302b may be applied to the primary backing 302a by any means that will allow a continuous distribution of the elastomer 302b to cover all or a portion of the primary backing 302a. One such means includes sewing the solid sheet form of elastomer 302b to the primary backing 302a. Another such means includes heating, extruding, and cooling the solid sheet form of elastomer 302b, which is preferably of a high viscosity and a low melt index, to the primary backing 302a.

In the present invention, the non-contiguous form of elastomer 302b is preferably applied to the primary backing 302a by heating the elastomer 302b, pumping the elastomer 302b onto the primary backing 302a through a die with small orifices, and cooling the elastomer 302b. The elastomer 302b used for this embodiment is preferably of a low viscosity and high melt index, as compared to the solid sheet elastomer 302b. Therefore, the elastomer 302b may be melted at a temperature between 150 degrees Fahrenheit and 300 degrees Fahrenheit.

Since the elastomer 302b in the non-contiguous form may be of a low viscosity, the elastomer 302b may be pumped onto the primary backing 302a. As described above, this technique differs from the one used for the solid sheet form of elastomer 302b which, due to its high viscosity, is preferably extruded. As one of ordinary skill in the art will readily recognize, pumping of the elastomer 302b, as opposed to extruding, is preferred in a manufacturing environment due to the lower cost realized by using this technique.

As illustrated in FIG. 3B, the non-contiguous form of elastomer 302b is preferably applied to the primary backing 302a on the side having the face 301a of the pile yarn fiber 301. One reason for this preferred placement of the elastomer 302b is that the soft elastomer 302b will be prevented from touching and possibly sticking to support rollers, which support the tufting backing 302 after the elastomer 302b is applied to the primary backing 302a.

Another reason the non-contiguous form of elastomer 302b may be preferred over the solid sheet form of elastomer 302b is due to the fact that the tufting backing 302 using the non-contiguous form of elastomer retains more strength subsequent to the pile yarn fibers 301 being tufted through the tufting backing 302 as described in more detail below. The reason for the lessened strength of the tufting backing 302 when using the solid sheet form of elastomer 302b is illustrated in FIG. 7A. Because the pile yarn fibers 301 are tufted through the elastomer 302b and the primary backing 302a, in which the elastomer 302b is bonded, the fibers of the primary backing 302a and the elastomer 302b tear or deteriorate when the tufting needles hit the tufting backing 302. This results because typically between 32 and 100 tufting needles penetrate a square inch of the tufting backing 302 during the tufting process.

On the other hand, as shown in FIG. 7B, when utilizing the non-contiguous form of elastomer 302b, the pile yarn fibers 301 may be tufted through voids created by the elastomer 302b (e.g., between the strands, dots, and dashes) or through side portions of the elastomer 302b, such that the fibers of the primary backing 302a may shift within a void 302d without tearing. The fibers of the primary backing 302 may shift because they are not completely immobilized by the elastomer 302b due to the void 302d. Therefore, when pile yarn fibers are tufted through the tufting backing 302, unlike with the solid sheet form of elastomer 302b, the primary backing fibers are less apt to tear or deteriorate resulting in the tufting backing 302 retaining much more strength after tufting.

FIGS. 7C and 7D illustrate the shifting of the fibers of the primary backing 302a that takes place when pile yarn fibers 301 are tufted through a void 302d created on the surface of the primary backing 302a. FIG. 7C shows the normal position of the fibers of the primary backing 302a located within a void 302d prior to being tufted by pile yarn fibers 301. Subsequent to the tufting, FIG. 7D depicts the shifted position of the fibers of the primary backing 302a within the void 302d, where the amount and direction of the shifting of the fibers of the primary backing 302a within the void 302d is predominately dependent on the size of the void 302a and the location of the tufted pile yarn fibers 301.

In fact, it has been found that a tufting backing 302 using the solid sheet form of elastomer 302b having a tensile strength of one hundred pounds per inch before tufting is typically reduced to approximately five pounds per inch, which is equal to a 40 pound basis weight paper, after tufting. On the other hand, when utilizing the non-contiguous form of elastomer 302b, the tensile strength is typically only reduced to approximately sixty pounds per inch. Therefore, the non-contiguous form of elastomer 302b may be further preferred in a manufacturing environment because of the enhanced retained strength of the resulting tufting backing 302 in addition to its lower cost to apply the elastomer 302b to the primary backing 302a.

Additionally, use of the non-contiguous form of elastomer 302b provides for a lighter tufting backing 302 and, thus, a lighter final carpet, as compared to the solid sheet form of elastomer 302b as well as prior art carpet using the secondary backing and latex as described in FIGS. 1 and 2. Therefore, the carpet utilizing the non-contiguous form of elastomer 302b will typically cost less to ship and be easier to install.

As described above, the non-contiguous form of elastomer 302b is initially prepared for application to the primary backing by melting the elastomer 302b. Since the elastomer is of a low viscosity, it may be melted at a temperature between 150 degrees Fahrenheit and 300 degrees Fahrenheit.

A preferred means of pumping the melted non-contiguous form of elastomer 302b onto the primary backing includes the use of a metering pump coupled to a die having small orifices. A preferred metering pump is the FSP-300-225-X produced by the Normag Corp. Division of the Dynisco Co. of Hickory, North Carolina. Equivalent metering pumps may also be used, including those manufactured by the Zenith Pumps Division of the Parker Hannifin Corp. of Sanford, North Carolina.

The die is preferably made of stainless steel. The size of the orifices are preferably between .020 inches and .0625 inches in diameter with .039 inches currently known to be the optimum diameter. The number of orifices per inch is preferably six to sixteen orifices with twelve currently known to be the optimum number. As one skilled in the art will appreciate, the die could be made of any equivalent material, such as tool steel, the orifices could be of almost any size, and the number of orifices per inch could be less than six or many more than twelve.

The non-contiguous form of elastomer 302b may be cooled by several means. These means include cooling the elastomer 302b at room temperature or cooling the elastomer 302b with one or more chilled rollers. When using the chilled rollers, the primary backing 302a with the elastomer 302b applied to it is preferably passed over the chilled rollers and the cooling temperature is preferably between 40 degrees Fahrenheit and 50 degrees Fahrenheit. Though fewer or more may be used, four chilled rollers have been found to optimize the cooling process. As one of ordinary skill in the art will readily recognize, other cooling systems may be used such as a ventilation system.

In order to improve the bonding of the elastomer 302b with primary backing comprising a 302a polypropylene (woven or non-woven) sheet, the primary backing 302a may be treated with one of several means. Means of treating the primary backing 302a include applying a corona discharge or gas flame treatment to the primary backing 302a. Since polypropylene may contain a variety of crystallinity levels the amount of treating may vary for different polypropylene primary backings 302a. As one of ordinary skill in the art will readily appreciate, other equivalent means may also be utilized to treat the primary backing 302a.

Another method of improving the bonding of elastomer 302b onto a woven primary backing 302a includes the use of a vacuum to suction the elastomer 302b into the primary backing 302a. This method improves the impinging of the elastomer 302b into the interstices of the woven fibers of the primary backing 302a. The vacuum may be created by any suitable vacuum or blower. A positive displacement blower of the size 12 x 12 HD, which is manufactured by BJI Inc. of Atlanta, Georgia or W.W. Meyer & Sons of Skokie, Illinois, has been found to generate adequate vacuum pressure. Moreover, a pressure blower, such as the G3582-100 manufactured by N.Y. Blower Co. of LaPorte, Indiana which runs at approximately 3500 r.p.m. has been found to perform adequately. Further, as one of ordinary skill in the art will readily appreciate, many other suitable equivalent vacuum type devices may be used.

The vacuum is preferably positioned below the orifices of the die and in close proximity to the primary backing 302a on the side of the primary backing 302a opposite the side of the pump. In a preferred embodiment, a vacuum of eight to twenty inches of water column is used. The number of inches of water column depends on the tightness of the weaving in the woven primary backing 302a where more inches of water column ore used for tighter, more close-knit weaves.

When using the non-contiguous form of elastomer 302b, a lubricant may also be placed on the side of the primary backing 302a opposite the side the elastomer 302b is applied. This lubricant facilitates the needles ability to tuft through the tufting backing 302 during the tufting process as described in more detail below. Moreover, the lubricant also decreases the friction created when the needles tuft the pile yarn fibers 301 through the tufting backing 302 resulting in less heat coming in contact with the pile yarn fibers 301.

Importantly, though the carpet industry currently primarily uses woven polypropylene primary backing 302a, where the fibers of the primary backing 302a are woven, the non-contiguous form of elastomer may be used with almost any type of primary backing 302a. These other types of primary backings 302a include, but are not limited to, cotton and jute materials and non-woven primary backings 302a.

In one embodiment, the elastomer 302b may comprise a thermoplastic elastomer. This type of elastomer may generally be thought of as a thermoplastic which may be melted many times without substantially changing its characteristics.

The thermoplastic elastomer may comprise ethylene/vinyl acetate, which is a known thermoplastic. For example, the thermoplastic elastomer 302b may comprise ethylene/vinyl acetate (EVA) available from a wide variety of sources, such as DuPont of Wilmington, Delaware, under the brand name of ELVAX (a trademark of DuPont).

In a preferred embodiment, the thermoplastic elastomer 302b may comprise ELVAX sold under the part number 220W, which has a melt index of 400, a percentage of vinyl acetate of 33%. Another suitable ELVAX is sold under the part number 140W, which has a melt index of 150, a percentage of vinyl acetate of 28%. It will be readily understood by one of ordinary skill in the art that the particular type of thermoplastic chosen for elastomer 302b is highly dependent upon the desired characteristics of the thermoplastic, and that thermoplastics are produced in many different types and with many different characteristics.

A distinct advantage which ethylene/vinyl acetate has over latex, which contains phenylcyclohexene, is that ethylene/vinyl acetate is considered to be non-carcinogenous (non-cancer-causing), while the same is not necessarily true for latex which contains phenylcyclohexene. Therefore, ethylene/vinyl acetate can more readily be used in carpet which will come into contact with humans or animals, while phenylcyclohexene cannot be used in this environment without posing a possible health hazard.

In addition to ethylene/vinyl acetate, other types of thermoplastics may be used for elastomer 302b. For example, elastomer 302b may comprise ethylene/methyl acrylate (EMA) available from many sources, such as Exxon Chemical of Houston, Texas under the brand name of Optima (a trademark of Exxon). Another type of elastomer 302b which may be used is ethylene/ethyl acetate (EEA) available from many sources, such as Union Carbide.

When using the non-contiguous form of elastomer 302b, a mixture containing between 50% and 80% EVA, between 10% and 30% EMA, and a tactifier is preferred depending on the pile yarn fibers 301 used. The EVA preferably contains between 30% to 40% vinyl acetate, the EMA preferably contains between 20% and 30% methyl acrylate, and the tactifier is preferably piccopale,

though other tactifiers such as amorphous polypropylene may be used. The type of surface found on the primary backing 302a dictates the proportions of vinyl acetate and methyl acrylate to use in the EVA and EMA, respectively. Moreover, the piccopale and amorphous polypropylene are used to improve the bonding of the ethylene/vinyl acetate elastomer 302b with the primary backing 302a and the pile yarn fiber.

In order to lessen the cost, or to otherwise modify elastomer 302b, different types of fillers may be added to elastomer 302b. Such filler is usually less expensive than the thermoplastic used for elastomer 302b, yet does not significantly reduce the effectiveness of elastomer 302b. An example of filler which may be mixed with elastomer 302b is aluminum hydrate, or clay, available from the Huber Company, Clay Division, of Macon, Georgia, and sold under the brand name of Huber 95 or KAOLIN (trademarks of Huber).

In one embodiment, where EVA is used as elastomer 302b and wherein the EVA is normally applied to primary backing 302a so that the EVA has a weight of 5-20 ounces/yard^2, filler may be added to the EVA before it is applied to primary backing 302a so that the resulting thermoplastic/filler mixture has a weight of 8-28 ounces/yard^2. Adding the filler may thus serve to add stiffness to the tufting backing 302.

In addition to filler, elastomer 302b may also be foamed in order to reduce the stiffness of the carpet, to expand the volume of elastomer 302b, and/or to lessen the weight. Foaming agents such as azodiacarbonamide, available from Uniroyal Chemical, under the brand name "Celogen" (a trademark of Uniroyal), may be used for this purpose. Of course other equivalent fillers and foaming agents may be used as well. In a preferred embodiment, tufting backing may be made with elastomer 302b to which filler has been added, but to which foam has not been added.

Referring to FIG. 4A, a process diagram is shown which depicts the various general steps which may be taken in order to make the tufted carpet shown in FIG. 3A. In step 401, one or more pile yarn fibers (reference numeral 301 in FIG. 3A) are tufted through a tufting backing (reference numeral 302 in FIG. 3A). As described above with respect to FIG. 3A., tufting backing 302 comprises a primary backing 302a, a secondary backing 302c, and an elastomer 302b. Alternatively, as shown in FIG. 3B, tufting backing may comprise primary backing 302a and elastomer 302b, without secondary backing 302c. The elastomer 302b is preferably a thermoplastic, such as ethylene/vinyl acetate, although other suitable materials could be used as well.

In step 401, the tufting of pile yarn fibers 301 may be accomplished by a method which is commonly known to those of ordinary skill in the art. In a preferred embodiment, pile yarn fibers 301 may be tufted by using tufting equipment available from Card Monroe Corporation, such as model number HST-420. It will be readily understood that there are numerous methods of tufting pile yarn fibers 301, and the present invention should not be construed to be limited to any one method.

After the pile yarn fibers 301 are tufted into tufting backing 302, in step 402 the carpet, and thus the pile yarn fibers 301, may be dyed to a specified color, and thereafter dried by applying heat. In addition to drying the previously dyed carpet, the heat also causes the elastomer (thermoplastic) 302b on the tufting backing 302 to soften around the pile yarn fibers 301. The softened thermoplastic 302b is therefore able to flow in and around pile yarn fibers 301.

The particular temperature to which tufting backing 302 is heated is dependent upon the particular dye utilized, as well as the characteristics of the thermoplastic 302b utilized. That is, the tufting backing 302 should be heated to just above the initial melting point of the thermoplastic 302b, but not too high so as to damage the tufting backing or the pile yarn fibers 301.

After tufting backing 302 is heated and thermoplastic 302b softens, tufting backing 302 may be cooled and rolled in step 403. In a preferred embodiment, tufting backing 302 may be cooled by exposing it to ambient room temperature. Importantly, cooling step 403 need not comprise a separate cooling step in the present invention, but may instead be performed implicitly by exposure to the surrounding environment.

Cooling the tufting backing 302 causes elastomer (thermoplastic) 302b to cool and solidify, which causes thermoplastic 302 to bond to pile yarn fiber 301. The pile yarn fibers 301 are thus bonded into place by thermoplastic 302b.

FIG. 4B depicts an alternate methodology for tufting and bonding pile yarn fibers 301 onto tufting backing 302. Particularly, step 451 corresponds to step 401 of FIG. 4A, where pile yarn fibers 301 are tufted into tufting backing 302. However, if pile yarn fibers 301 are predyed, then step 402 in FIG. 4A need not be performed. Instead, stop 452 of FIG. 4B is performed, whereby the elastomer 302b is heated to a softening point (thus allowing elastomer 302b to flow in and around pile yarn fibers 301). Step 452 may be accomplished by heating the elastomer 302b in an oven or an equivalent heating means. Since the pile yarn fibers 301 are not dyed, the heating time for this step can be 30% to 50% faster because the pile yarn fibers 301 do not need to be dried. Moreover, the heating time for this step

may be in even greater percent faster when compared to drying frothy latex as described for prior art carpet.

In step 453, the elastomer is cooled, for example, to room temperature or another specified temperature, to allow pile yarn fibers 301 to bond to elastomer 302b. Once again, cooling step 453 need not comprise a separate step in the present invention, but may instead be performed implicitly by exposure to the surrounding environment.

The process described above with respect to FIGS. 4A and 4B, as well as the tufted carpet shown in FIGS. 3A and 3B, has numerous advantages over the carpet described in FIGS. 1 and 2. First, because tufting backing 302 is used instead of separate primary backing 102, latex 103 and secondary backing 104 (as shown in prior art FIG. 1), the present invention requires that fewer different types of material need be inventoried and assembled during the manufacturing stage of the carpet. Rather, the tufting backing 302 of the present invention may be more efficiently made part of the carpet. This results in less equipment necessary for the manufacturing of the carpet, less complex equipment, faster manufacturing time, less necessary manufacturing space, less inventory, and a resulting cost savings.

Additionally, because thermoplastic 302b is melted in and around pile yarn fibers 301, and thereafter bonds to pile yarn fibers 301 when cooled, a greater bonding of pile yarn fibers 301 is achieved when compared to merely coating latex to the pile yarn fibers 301, so that pile yarn fibers 301 may not be easily pulled out of the tufting backing 302.

Another advantage found in the tufted carpet of the present invention is the elimination of the roughness found in carpets using the application of latex (reference numeral 103 in FIG. 1) and calcium carbonate after the pile yarn fibers 101 are tufted into the primary backing. Although a secondary backing 104 may be applied to those carpets, the general roughness of the back of those carpets makes installation of the carpet difficult in certain situations. This roughness is not found in the tufted carpet of the present invention, as the back of the pile yarn fibers 301 make a smoother and more attractive surface on the back of the carpet.

The above-described advantages over the prior known processes and apparatuses are included for example purposes only. The present invention includes many other advantages over the prior art, as will be readily understood by one of ordinary skill in the art.

Whilst the present invention has been described primarily with reference to carpets and backing therefor, the teachings of the present invention could be applied to materials or fabrics other than carpet.

Claims

1. A method of making tufting backing (302) adapted for tufting pile yarn fibers (301) therethrough, the method comprising the steps of:
   (a) preparing an elastomer (302b) for application to a primary backing (302a); and,
   (b) applying the elastomer (302b) to a first side of the primary backing (302a), wherein the elastomer is applied to the primary backing in a form which creates at least one void (302d) on the first side of the primary backing.

2. A method according to claim 1, wherein the at least one void on the first side of the primary backing is created by applying the elastomer to the primary backing in portions having shapes selected from the group consisting of: (1) a strand; (2) a dash; and, (3) a dot.

3. A method according to claim 1 or claim 2, wherein the preparing step includes heating the elastomer whereby the elastomer melts.

4. A method according to any of claims 1 to 3, wherein the elastomer has a low viscosity.

5. A method according to any of claims 1 to 4, further comprising the step of treating the first side of the primary backing for accepting the elastomer prior to the applying step.

6. A method according to claim 5, wherein the first side of the primary backing is treated with a corona discharge in the treating step.

7. A method according to claim 5, wherein the first side of the primary backing is treated with a gas flame in the treating step.

8. A method according to any of claims 1 to 7, wherein the elastomer is applied to the primary backing in the applying step by pumping the elastomer through at least one orifice in a die.

9. A method according to any of claims 1 to 8, further comprising the step of cooling the elastomer whereby the elastomer hardens subsequent to the applying step.

10. A method according to claim 9, wherein the elastomer is cooled in the cooling step with at least one chilled roller.

11. A method according to any of claims 1 to 10, further comprising the step of placing a lubricant on a side of the primary backing subsequent to the applying step.

12. A method according to claim 11, wherein the lubricant in the placing step is placed on a second side of the primary backing.

13. A method according to any of claims 1 to 12, further comprising the step of suctioning the elastomer to the primary backing during to the applying step.

14. A tufting backing (302) adapted for tufting pile yarn fibers (301) therethrough, the tufting backing comprising:
(a) a primary backing (302a); and,
(b) an elastomer (302b) applied to a first side of the primary backing (302a), wherein the elastomer is applied to the primary backing in a form which creates at least one void (302d) on the first side of the primary backing.

15. A tufting backing according to claim 14, wherein the at least one void on the first side of the primary backing is created by applying the elastomer to the primary backing in portions having shapes selected from the group consisting of: (1) a strand; (2) a dash; and, (3) a dot.

16. A method of making carpet, the method comprising the steps of:
(a) applying an elastomer (302b) to a first side of a primary backing (302a) having at least one primary backing fiber, wherein the elastomer is applied to the first side of the primary backing in a form which creates at least one void (302d) on the first side of the primary backing; and,
(b) tufting at least one pile yarn fiber (301) through the primary backing with a tufting needle wherein the at least one void allows the at least one primary backing fiber to shift when the tufting needle meets the at least one primary backing fiber.

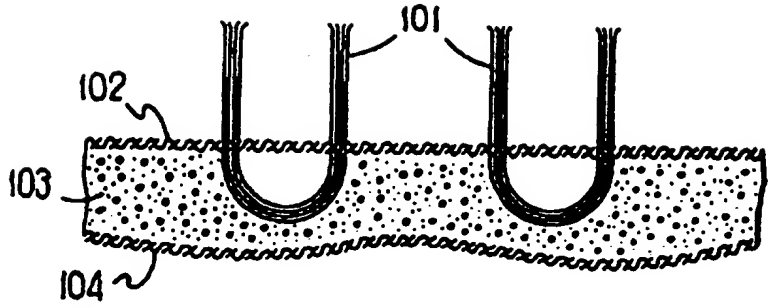
17. A method according to claim 16, wherein the at least one void on the first side of the primary backing is created by applying the elastomer to the primary backing in portions having shapes selected from the group consisting of: (1) a strand; (2) a dash; and, (3) a dot.

18. A method according to claim 16 or claim 17, further comprising the step of:
(c) bonding the at last one pile yarn fiber to the primary backing with the elastomer.

19. A method according to claim 18, wherein step (c) includes heating the elastomer, whereby the elastomer softens, and cooling the elastomer, whereby the elastomer hardens.

20. Carpet comprising:
(a) a primary backing (302a) having at least one primary backing fiber;
(b) an elastomer (302b) applied to a first side of the primary backing in a form which creates at least one void (302d) on the first side of the primary backing; and,
(c) at least one pile yarn fiber (301) tufted through the primary backing with a tufting needle, wherein the at least one void allows the at least one primary backing fiber to shift when the tufting needle meets the primary backing fiber.

21. Carpet according to claim 20, wherein the at least one void on the first side of the primary backing is created by applying the elastomer to the primary backing in portions having shapes selected from the group consisting of: (1) a strand; (2) a dash; and, (3) a dot.



PRIOR ART

FIG 1

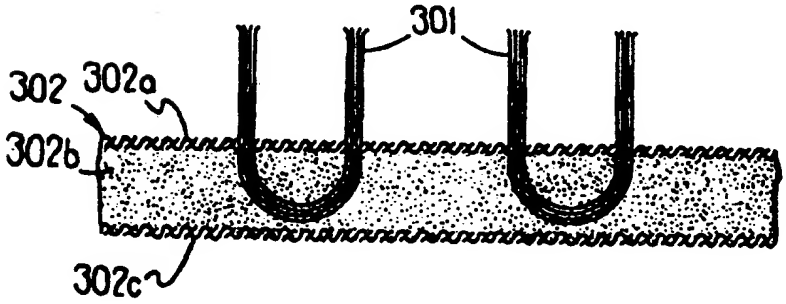


FIG 3A

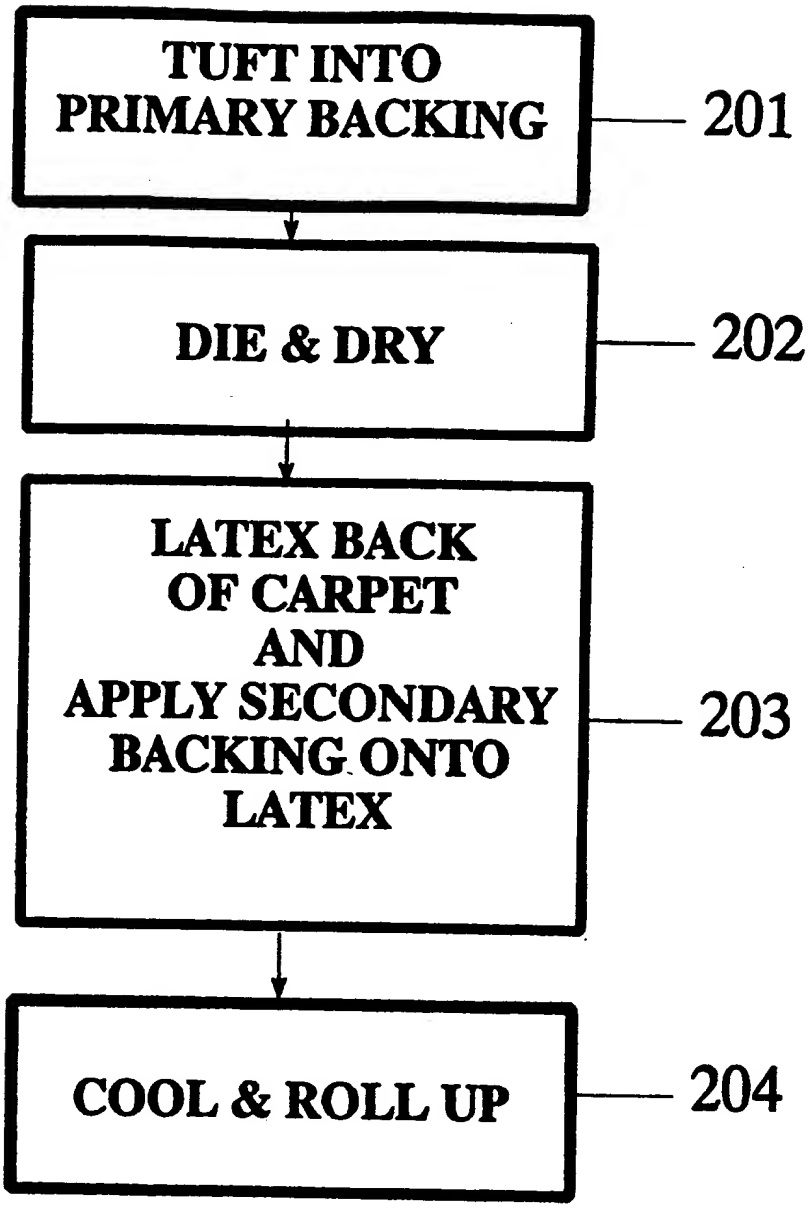


FIG. 2
(PRIOR ART)

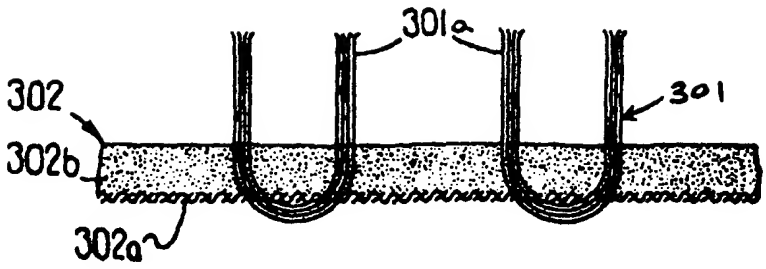


FIG 3B

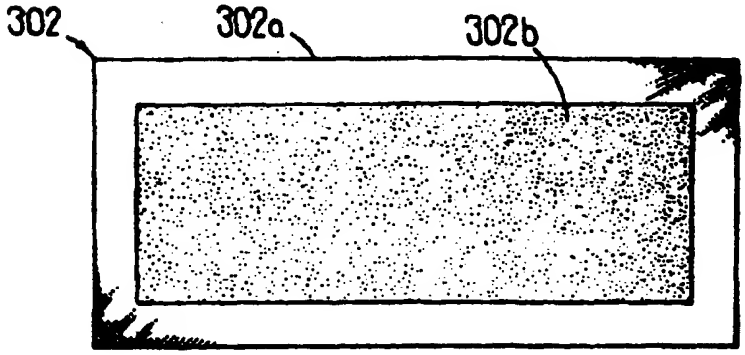


FIG 6A

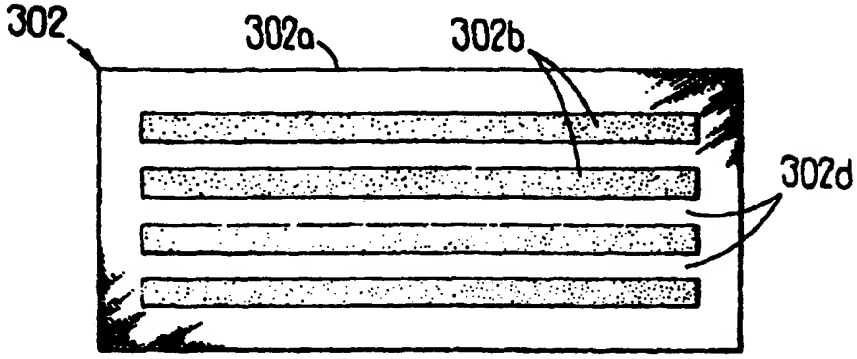


FIG 6B

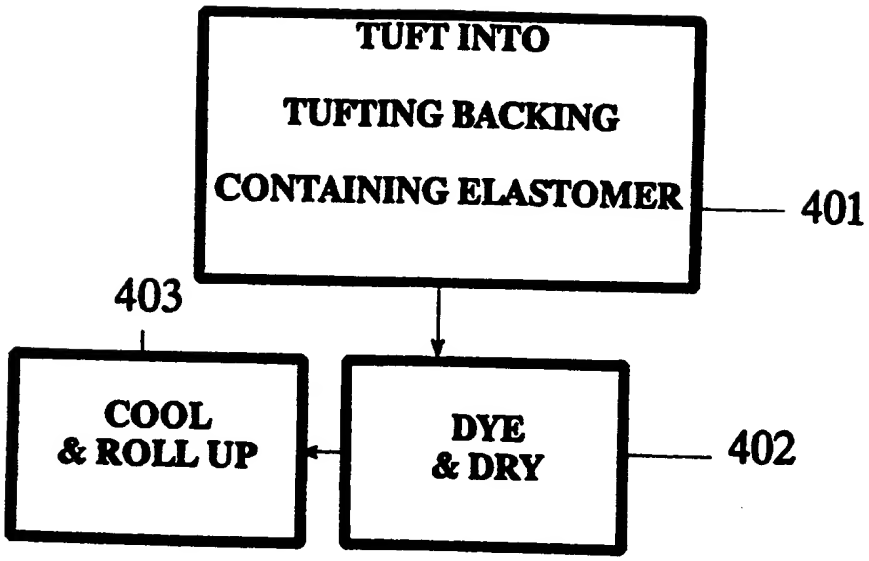

TUFT INTO
TUFTING BACKING
CONTAINING ELASTOMER
401
403
COOL
& ROLL UP
DYE
& DRY
402

FIG. 4A

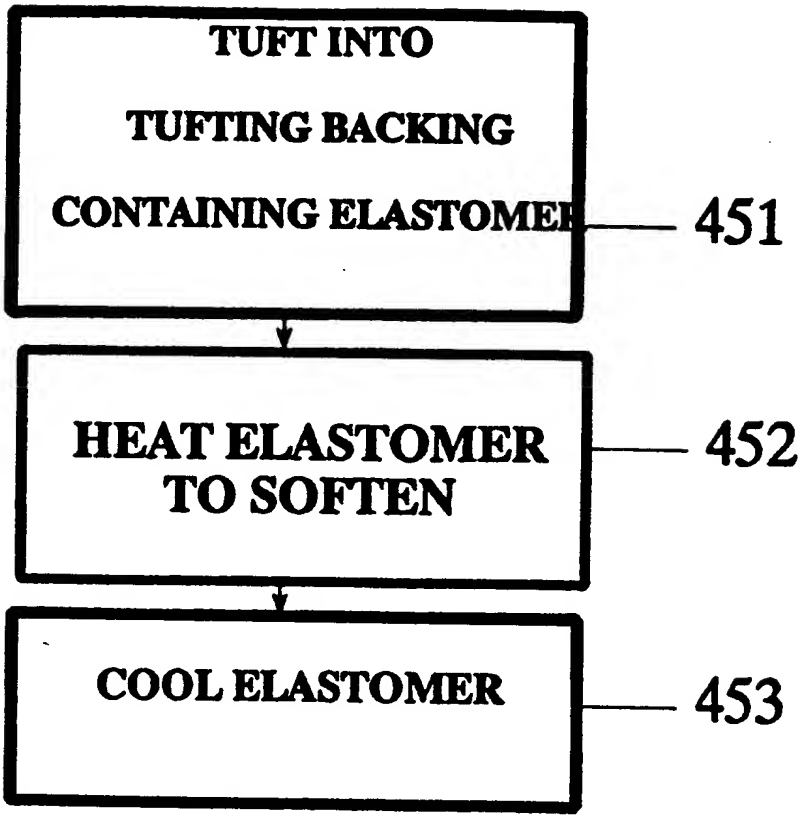

TUFT INTO
TUFTING BACKING
CONTAINING ELASTOMER
451
HEAT ELASTOMER TO SOFTEN
452
COOL ELASTOMER
453

FIG. 4B

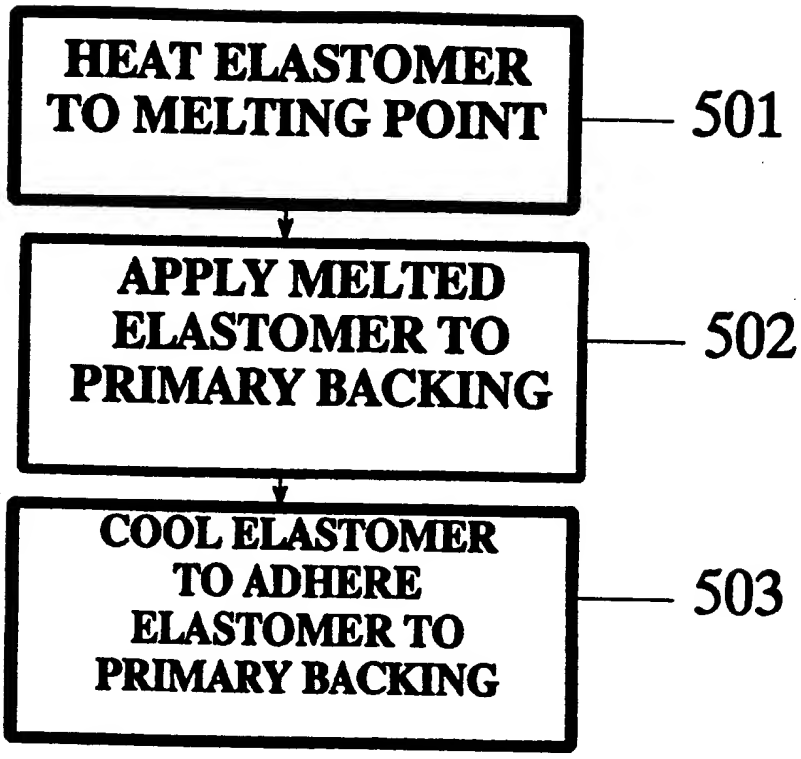

HEAT ELASTOMER TO MELTING POINT
501
APPLY MELTED ELASTOMER TO PRIMARY BACKING
502
COOL ELASTOMER TO ADHERE ELASTOMER TO PRIMARY BACKING
503

FIG. 5

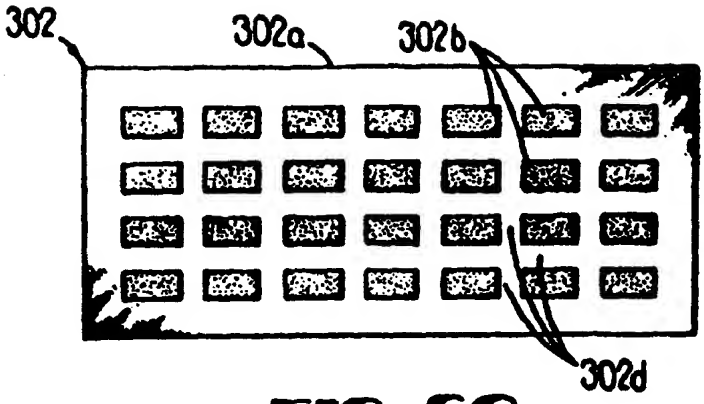


FIG 6C

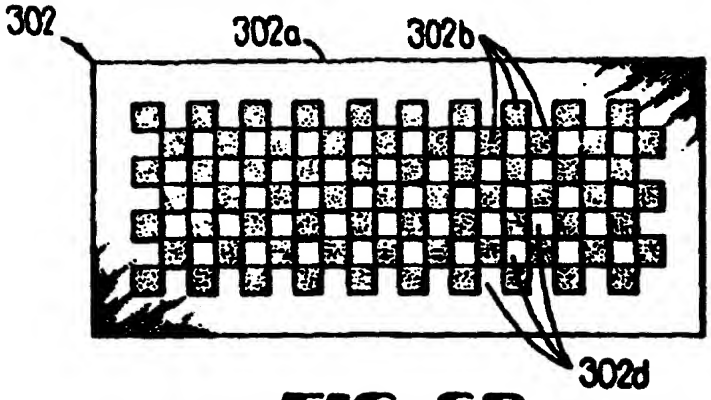


FIG 6D

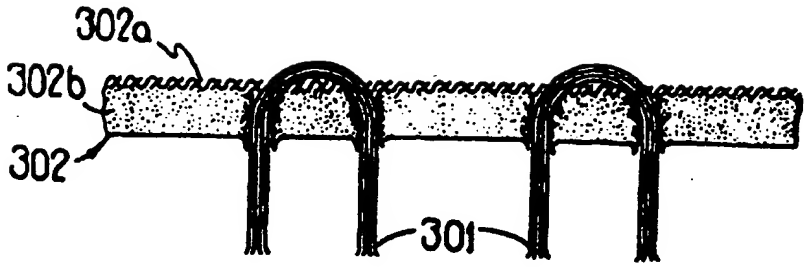


FIG 7A

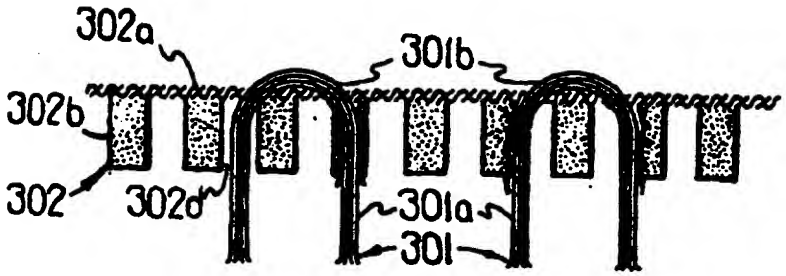


FIG 7B

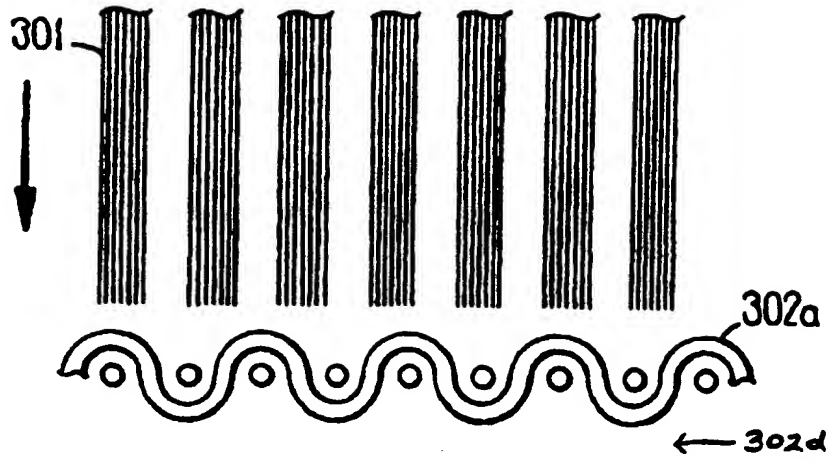


FIG 7C

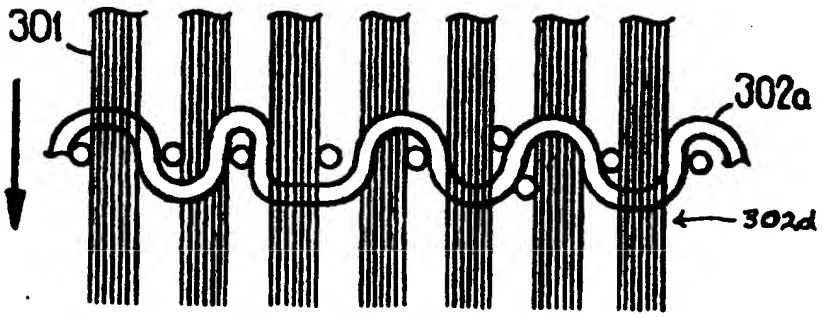


FIG 7D